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B. T. GALLOWAY, Chief of Bureau.

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# THE FIELD TREATMENT OF TOBACCO ROOT-ROT.

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# THE FIELD TREATMENT OF TOBACCO ROOT-ROT.

## NATURE OF ROOT-ROT.

During the past few years a disease known as root-rot has made its appearance in the tobacco fields in some districts of Kentucky, Connecticut, Ohio, and Wisconsin. This disease is now generally recognized to be due to a soil fungus<sup>a</sup> (*Thielavia basicola*), which attacks the feeding roots of the tobacco as fast as they are thrown out. The root-rot generally makes its first appearance in the field in spots, particularly low spots, and may later develop throughout the field. The most striking feature is the failure of the plants to make a proper growth. The diseased plants are often only 8 or 10 inches high when healthy plants set at the same time are ready to be cut. These small plants will be found to have only a small ball of stubby roots, and the fungus can be seen on the blackened or brownish ends of the roots, which in the active stages of the disease have a rotted appearance.

Root-rot has already been successfully checked in the seed-bed by Selby<sup>b</sup> with the use of formalin, and by Shamel<sup>c</sup> through sterilization by steam. Nether of these methods can be considered practicable for treating the disease in the field. In experiments made last year by W. W. Gilbert and the writer, a formalin solution applied to a one-tenth acre plot of diseased land at the rate of 500 pounds of formalin per acre<sup>d</sup> gave somewhat increased yields, but not sufficient to justify the expense involved.

## FIELD TREATMENT OF ROOT-ROT.

The object of this circular is to give briefly the preliminary results of the writer's efforts to overcome the attacks of this fungus on the tobacco in the field by the proper use of fertilizers, with the hope

<sup>a</sup> See papers by Selby, of the Ohio Agricultural Experiment Station, and by Clinton, of the Connecticut Agricultural Experiment Station. Mr. W. W. Gilbert, of the Department of Agriculture, has a bulletin on this subject in preparation.

<sup>b</sup> Circular No. 59, Ohio Agricultural Experiment Station.

<sup>c</sup> Bulletin No. 91, Bureau of Plant Industry, Department of Agriculture, 1936.

<sup>d</sup> This would represent a cost of about \$60 per acre for the formalin alone, besides the labor.

that the suggestions offered can be utilized this season by tobacco growers who have fields affected with this disease. The results of the writer's investigations thus far indicate that the tobacco is much more severely injured by the fungus on fields where the soil has been made alkaline by the long-continued use of large amounts of lime, ashes, and fertilizers containing carbonate of potash. The remedy for diseased soils appears, then, to consist in avoiding the use of lime and in applying the necessary potash in the form of the sulphate of potash, which is a neutral salt; and, if the field is badly diseased, in applying the phosphoric acid in the form of acid phosphate in order to help neutralize the alkalinity of the soil. The above view as to the cause of the development of the disease in some of the tobacco fields of Connecticut is in harmony with field observations, as will appear in the following pages.

#### OCURRENCE OF ROOT-ROT.

The fungus causing this disease is one commonly found in leaf mold and decaying organic matter, and therefore may reasonably be expected in any new land. The fact that the disease does not occur on tobacco fields until they have been in tobacco for several years indicates that the fungus may be present in the soil without attacking the tobacco. If we grant this point, then some condition which favors the development of the fungus on the tobacco roots must develop in the soil after several crops of tobacco have been grown.

Root-rot in the Connecticut Valley is especially prevalent in fields on which unusually large quantities of fertilizers have been used. The development of the disease is not, however, due to too high a percentage of soluble salts in the soil. This point was tested both in the greenhouse and in the field, and it was found that the growth of tobacco upon diseased soils was better when a liberal quantity of neutral fertilizers was used than when smaller amounts were employed. If the root system of the tobacco is greatly reduced by the root-rot, the plants that are fertilized liberally and thus have a large amount of available plant food immediately at hand will make the best growth. Heavy fertilizing will not overcome the effects of the root-rot, however, and if alkaline fertilizers are used the growth will actually be decreased, as the following experiments show:

#### FIELD EXPERIMENTS SHOWING THE BAD EFFECTS OF ALKALINE COMMERCIAL FERTILIZERS ON ROOT-ROT SOILS.

During the season of 1907 a series of fertilizer experiments were tried on two diseased fields in the Connecticut Valley. These tests were confined mainly to fertilizers which have been extensively used in tobacco growing in Connecticut. No acid salts or ready-mixed

fertilizers were used. While none of the fertilized plots on the badly diseased fields gave yields equal to those obtained from adjacent fields free from disease, large differences in yield were obtained from the fertilized plots. In all cases it was found that the plots on which carbonate of potash was used gave the smallest plants and the lowest yields. The use of lime with the carbonate of potash still further diminished the yield. The use of carbonate of potash and lime with cotton-seed meal and ground fish gave a yield of but 900 pounds per acre. This yield was 200 pounds less to the acre than when no fertilizer was used and was only a little more than half the yield obtained from some of the other plots. These results indicate that the alkaline condition of the soil resulting from the use of carbonate of potash and lime favored the development of the root-rot.

#### GREENHOUSE EXPERIMENTS WITH ALKALINE FERTILIZERS.

The effect of alkaline fertilizers was tested further in a series of greenhouse experiments made with a diseased soil from Connecticut. All the pots were fertilized uniformly with cotton-seed meal. To some of the pots one-half per cent of air-slaked lime was also added. This cut down the weight of tobacco to nearly one-half (53 per cent). Adding 2 per cent of lime decreased the weight to 35 per cent of that of the check plots. In soils free from root-rot, the use of 1 per cent of lime gave a better growth of tobacco than when no lime was used. This shows that the lime does not injure the tobacco directly. The application of land plaster to the diseased soil in amounts varying from one-half of 1 per cent to 2 per cent had no bad effects and even slightly increased the growth of tobacco. When lime was used with land plaster the weight again decreased, averaging about 40 per cent of that of the checks. The use of carbonate of potash in addition to the cotton-seed meal decreased the weight of the tobacco to about 80 per cent of the checks in spite of the fact that additional plant food was added. The use of hydrochloric acid, on the other hand, increased the yield by about 10 per cent, although this acid carries no plant food.

The plants in the check pots in these experiments made a good growth and were not seriously injured by the root-rot, although the fungus could be seen on the roots. The root systems of the plants in all the pots to which lime or carbonate of potash was added were badly diseased. The roots of the plants grown in the soil in which land plaster was used showed some disease, about like that of the check pots. The roots of the plants grown in the acid-treated soil were perfectly clean and white, and entirely free from the fungus.

The soil used was originally from a badly diseased field. For a year prior to these experiments it was used for growing tobacco in shallow greenhouse beds provided with good drainage. This treatment

greatly reduced the effect of the root-rot. The improvement was doubtless due in part to the leaching away of the lime in watering. The sandy tobacco soils of Connecticut, which leach readily, are not affected with root-rot. It is highly significant that the root-rot in this soil reestablished itself with all its old vigor when the soil was made alkaline through the addition of lime.

#### SUMMARY.

The tobacco root-rot is caused by a soil fungus.

The fungus attacks the tobacco roots most severely when the soil has become alkaline, due to the use of too large amounts of lime, ashes, or fertilizers containing carbonate of potash.

*Remedy.*—Use no lime on diseased fields. Apply potash in the form of sulphate of potash or double manure salts. Apply phosphoric acid in the form of acid phosphate or dissolved bone to correct the alkalinity of the soil. Plaster can be used if desired.

Where other land is available for tobacco, use the diseased fields for some other crop for a year or more. Use no lime or alkaline form of fertilizer until the roots of the tobacco are free from the disease. Lime and alkaline fertilizers can then be used cautiously.

[Circ. 7.]